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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Stocking of Reproduction on Spruce-Fir Clearcuttings in Colorado

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Stocking on 200- to 400-foot-wide clearcut strips was determined on 99 cutting units on 8 National Forests. Stocking to reproduction and residual understory trees of good quality will insure an adequate replacement stand on all cutting units examined. Stocking to new reproduction was related to seedbed condition, aspect, slope, amount of slash, vegetative abundance, soil texture, width and direction of cut strip, and the number of years since cutting.

One of the most difficult problems in the management of Engelmann spruce (Picea engelmanni Parry) subalpine fir (Abies lasiocarpa (Hook.) Nutt.) forests in Colorado is the apparent inconsistency of natural regeneration after clearcutting. Seedlings become established on many clearcut areas in a reasonable period of time if seed is available in sufficient quantities. There are other clearcut areas, however, that fail to restock even though conditions appear to have been favorable for regeneration.

In 1959, recently clearcut spruce-fir stands were surveyed to determine the relative importance of several environmental factors and cutting-unit characteristics influencing seedling establishment. This paper summarizes the effect on stocking of the factors and characteristics considered.

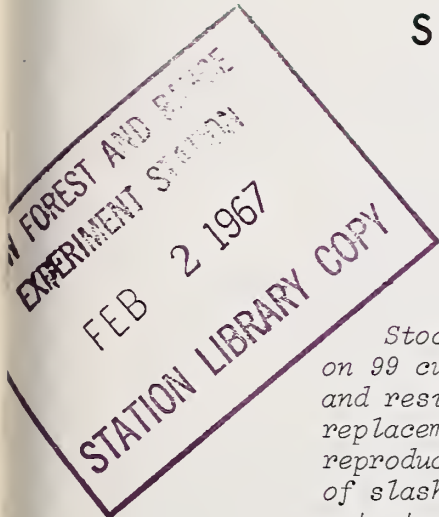
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Study Areas

Observations were made on 99 cutting units on the following 8 sale areas in Colorado:

<u>Drainage</u>	<u>National Forest</u>
Supply Creek	Arapaho
Trap Creek	Roosevelt
East Fork Willow Creek	Routt
South Fork Slater Creek	Routt
Beaver Creek	San Isabel
North Fork Mancos River	San Juan
Silver Creek	White River
Red Sandstone Creek	White River

The cutting units sample a wide range of conditions. Slopes vary from 10 to about 60 percent, and aspect embraces all compass directions. Soils are mostly light-textured, gravelly and sandy loams, derived mainly from granitic and coarse sedimentary rocks. Ground vegetation, principally grouse whortleberry (Vaccinium scoparium Leiberg), was little altered by cutting.



All cutting units were logged between 1952 and 1956. Timber was harvested by commercial clearcutting in either alternate strips 200 feet wide at right angles to the contour, or alternate strips 200 to 400 feet wide parallel to the contour. The clearcut strips differed in length, but all points on the units sampled were within 200 feet of a seed source. Logging slash and unmerchantable residual understory trees were left untreated. Seedbed preparation was limited to that created by logging. Logs were skidded with horses on most areas, but tractors and jammers were used on some.

Field Examination

Approximately 1 to 1-1/2 percent of the area cut on each unit was systematically sampled with 1/300-acre plots. The following information was recorded on 1,748 plots:

Stocking: Growing stock was classed as (1) subsequent reproduction, (2) advanced reproduction, and (3) residual understory (trees 3.6 inches d.b.h. and larger). Spruce and fir were tallied separately. Only advanced growth of good quality and subsequent reproduction 1 inch tall or taller were considered to be growing stock.

Seedbed: Classified as (1) undisturbed, (2) disturbed, and (3) skidroad, on the basis of the condition containing the oldest subsequent reproduction. If no subsequent reproduction was present, seedbeds were classified on the basis of the largest percentage of seedbed condition on the plot. Condition was determined in 1959 on the basis of the probable condition immediately after logging.

Aspect: Recorded to the nearest cardinal point.

Slope: Measured in percent.

Slash cover: Rated on the percentage of ground actually covered on each plot as (1) none--less than 10 percent, (2) light--10 to 39 percent, (3) medium--40 to 69 percent, and (4) heavy--70 percent or more.

Abundance of vegetation: Rated on the basis of the percentage of ground actually occupied

by vegetation as (1) light--scattered cover with bare soil between plants, (2) medium--moderate cover, and (3) heavy--dense cover.

In addition, time since cutting, width, direction with respect to the contour, direction with respect to the prevailing winds, parent soil material, and general soil texture were recorded for each unit.

Analysis of Data

Total stocking on areas sampled was rated on the proportion of sample plots stocked by all species and classes of reproduction as:

Fully stocked--100 percent,
Well stocked--70 to 99 percent,
Moderately stocked--40 to 69 percent,
Poorly stocked--10 to 39 percent,
Nonstocked--less than 10 percent.

Stocking to subsequent reproduction only was used in evaluating the effects of environmental factors and cutting-unit characteristics. Apparent relationships were tested by "Chi Square" and regression analyses.

Results

Stocking: Average stocking to all classes of growing stock was 83 percent (fig. 1). About two-thirds of the sample plots were stocked to fir, and more than half were stocked to spruce. Advanced reproduction stocked 61 percent of the plots sampled, and subsequent reproduction stocked 54 percent. Stocking to advanced reproduction was predominantly fir, but stocking to subsequent reproduction was evenly distributed between spruce and fir (fig. 1).

Seedbed condition: Spruce and fir reacted differently to seedbed condition. Spruce stocking was significantly better on disturbed and skidroad seedbeds than on undisturbed seedbeds. Stocking to fir was significantly better on undisturbed seedbeds than on skidroad seedbeds, but did not differ significantly between disturbed and undisturbed seedbeds (fig. 2).

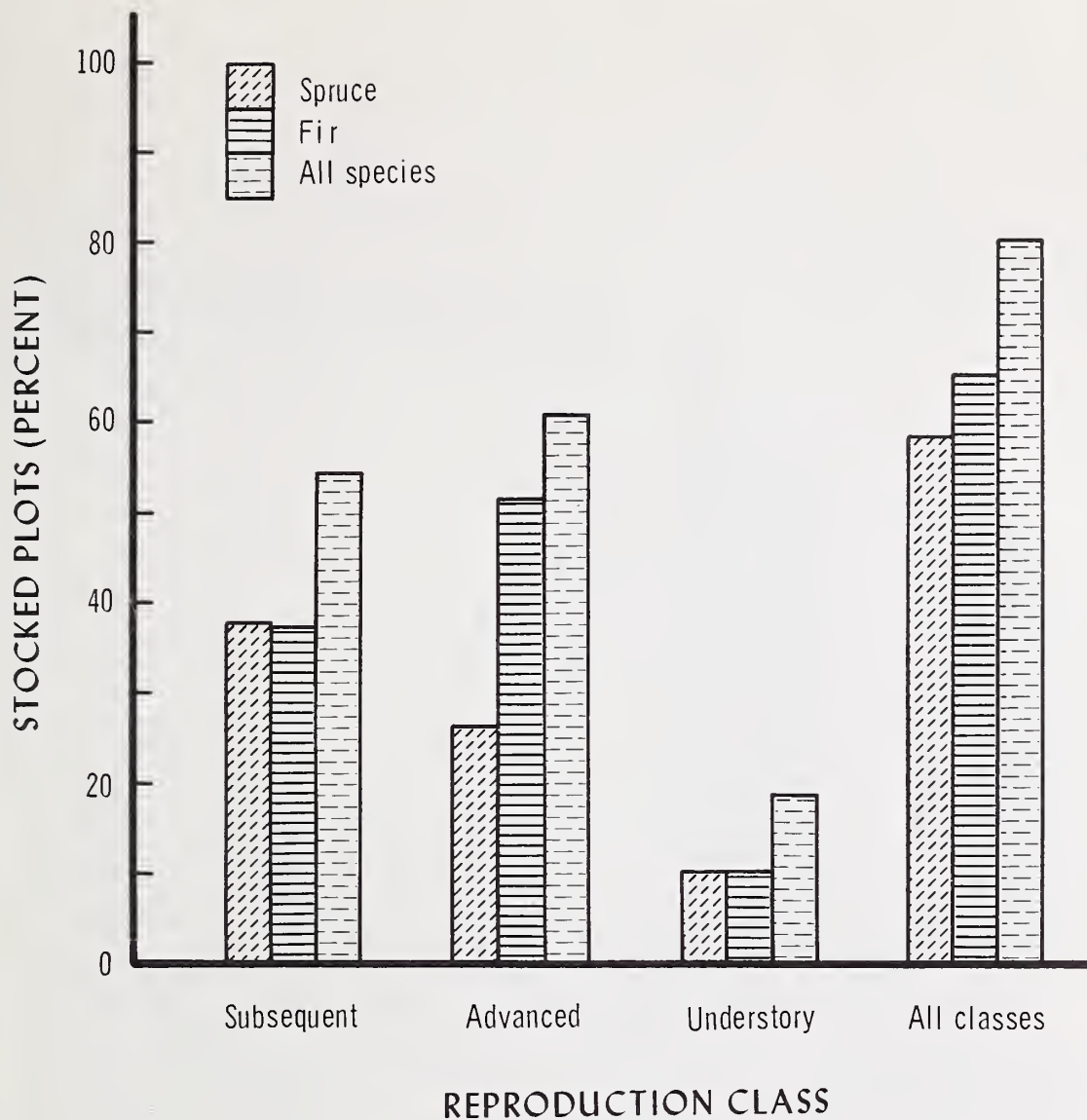


Figure 1.--Average stocking by reproduction classes.

Aspect:² Stocking to both spruce and fir differed substantially among aspects. In general, stocking was higher on northerly and westerly aspects and lower on southerly aspects (S and SW in particular). Stocking on

It seems reasonable that slope should influence stocking differently among different aspects. Reason dictates that there is likely to be little difference in stocking between northerly and southerly aspects as slope gradient approaches zero, but as slope steepness increases, difference in stocking between those aspects should increase. Minimum stocking on southerly aspects should be on slopes that face at right angles to the sun in midsummer, but there is no reason to believe that slopes of 20 to 30 percent on northerly aspects should be less favorable to reproduction than level ground. However, our sample was too small to establish dependable averages of stocking for combinations of aspect and slope.

east aspects represented about average conditions for exposure (fig. 3).

Slope:² Stocking to both spruce and fir was related to slope gradient. Stocking was lowest on plots with the least slope (10 percent), and remained relatively unchanged as slope steepness increased to about 20 percent. Stocking then increased rapidly as slopes became steeper and was maximum on the steepest slopes encountered (fig. 4).

Slash cover: The proportion of ground covered by residual slash influenced stocking to both spruce and fir. Stocking was above average on areas where slash covered less than 40 percent of the plot area, and below average where slash cover was 40 percent and greater (fig. 5).

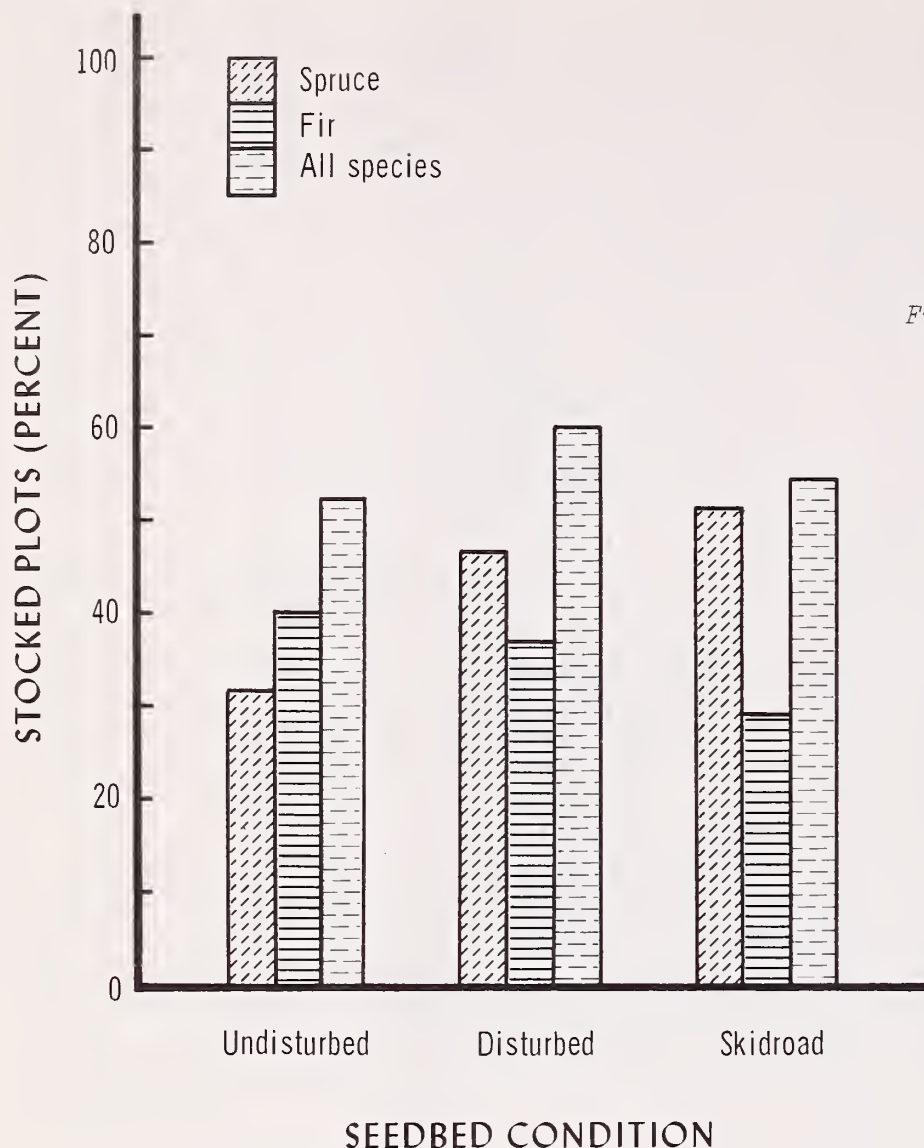


Figure 2.--Average stocking to subsequent reproduction, by seedbed condition.

Abundance of vegetation: Ground vegetation was beneficial to both spruce and fir stocking. Stocking to spruce was significantly better where vegetation was medium or heavy than where it was light (fig. 6). Where vegetation was heavy, competition appears to have offset any additional beneficial effects. Stocking to fir was highest where vegetation density was heaviest (fig. 6). The increase in stocking associated with an increase in vegetation density may have been due to an improvement in microenvironment caused by shading and mulching.

Cutting-unit characteristics: Stocking to spruce decreased as size of opening increased, but stocking to fir increased. Stocking to spruce averaged 39 percent on units 200 feet wide compared to 32 percent on units 400 feet wide. Stocking to fir averaged 32 percent on

units 200 feet wide, and 65 percent on units 400 feet wide.

Cutting units at right angles to the contour were better stocked to spruce (43 percent) than units with boundaries parallel to the contour (29 percent). Stocking to fir averaged 45 percent on units parallel to the contour compared to 33 percent on units at right angles to the contour.

Average stocking to both spruce and fir was little influenced by the direction of cutting-unit boundaries with respect to prevailing winds. Spruce was stocked on 40 percent of the units with cutting boundaries parallel to the direction of the prevailing westerly and southwesterly winds, compared to 35 percent on units with cutting boundaries at right angles to the prevailing wind. Average stocking to fir was 37 to 38 percent, respectively.

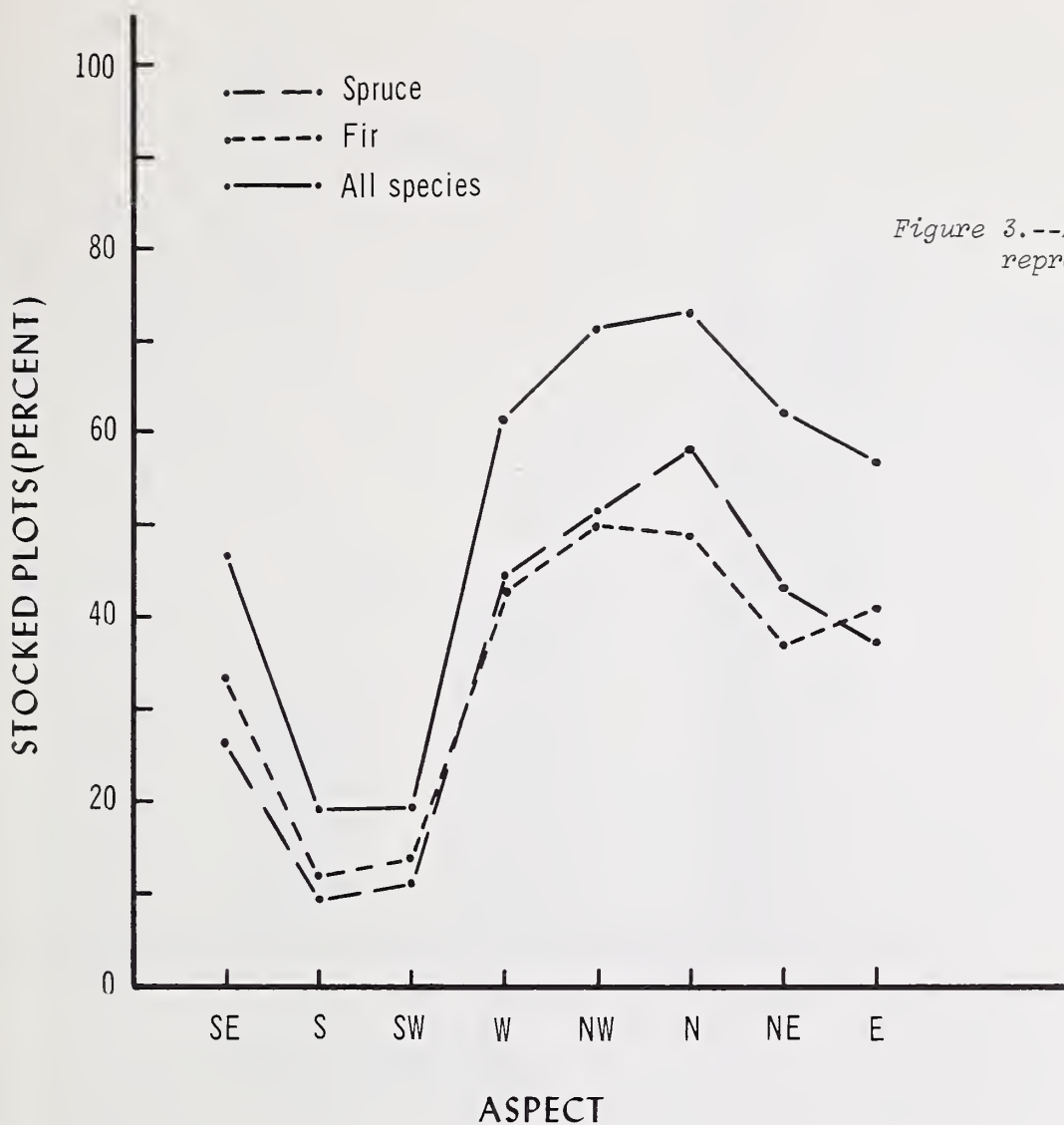


Figure 3.--Average stocking to subsequent reproduction, by aspect.

Parent soil material influenced stocking more than soil texture. Stocking to both spruce and fir was better on light-textured soils derived from coarse sandstone than on light-textured soils derived from granitic rock. Stocking was also below average on medium-textured soils derived from a variety of parent materials (table 1).

Stocking to both spruce and fir increased with time since logging, but fir established more quickly than spruce. Stocking to spruce was above average 6 or more years after cutting, and was highest after 7 years. Stocking to fir was above average after 4 or more years, but did not increase with additional time beyond 4 years (table 1).

Conclusions and Summary

Present stocking to reproduction and residual understory trees of good quality will insure an adequate replacement stand on all cutting units examined. The North Fork Mancos River and Beaver Creek were rated as moderately stocked; all other areas were rated as well stocked.

Advanced reproduction contributed substantially to total stocking on all areas examined. Although the composition was largely fir, advanced reproduction is established growing stock, and care should be taken to minimize logging damage to this valuable resource.

Figure 4.--Average stocking to subsequent reproduction, by slope.

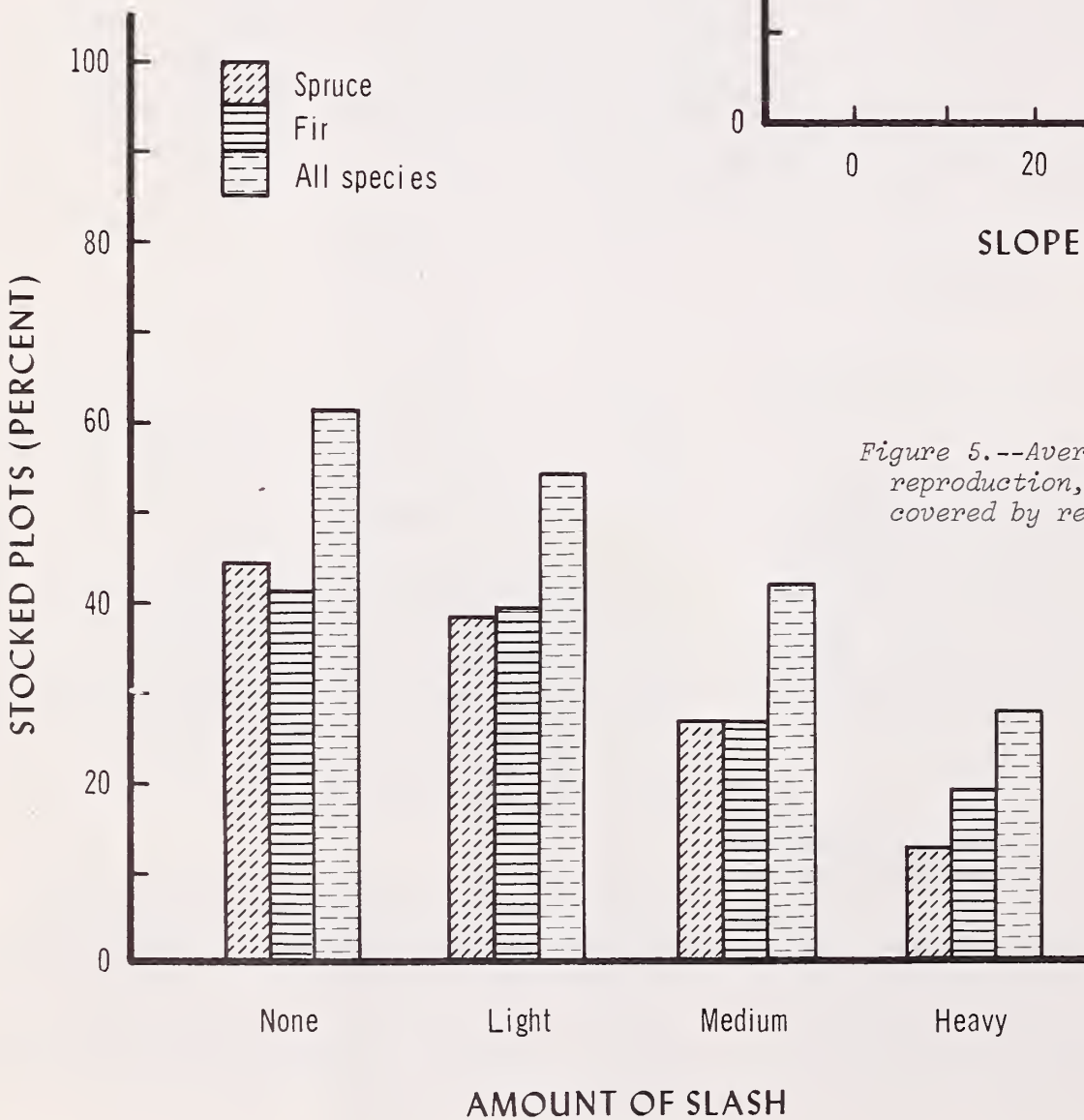
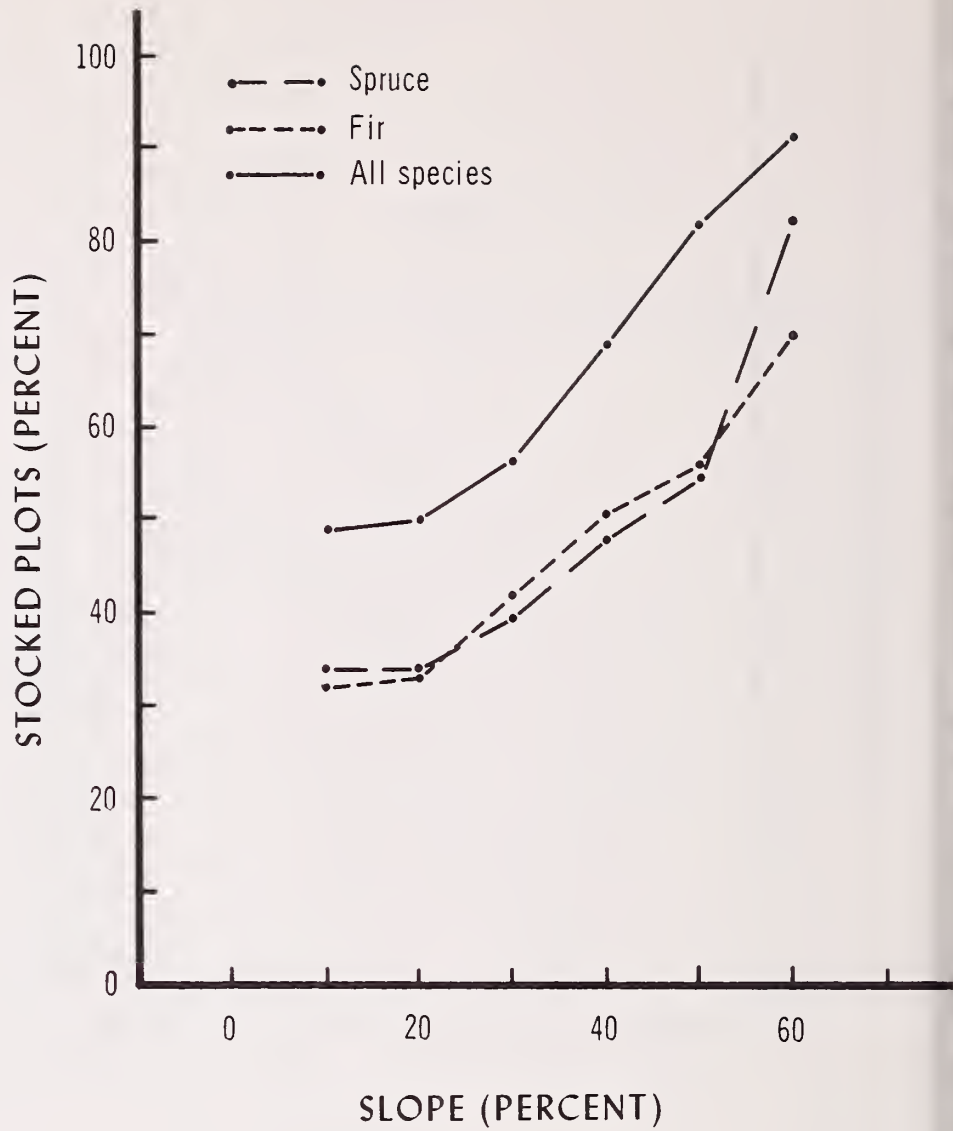


Figure 5.--Average stocking to subsequent reproduction, by the proportion of ground covered by residual slash.

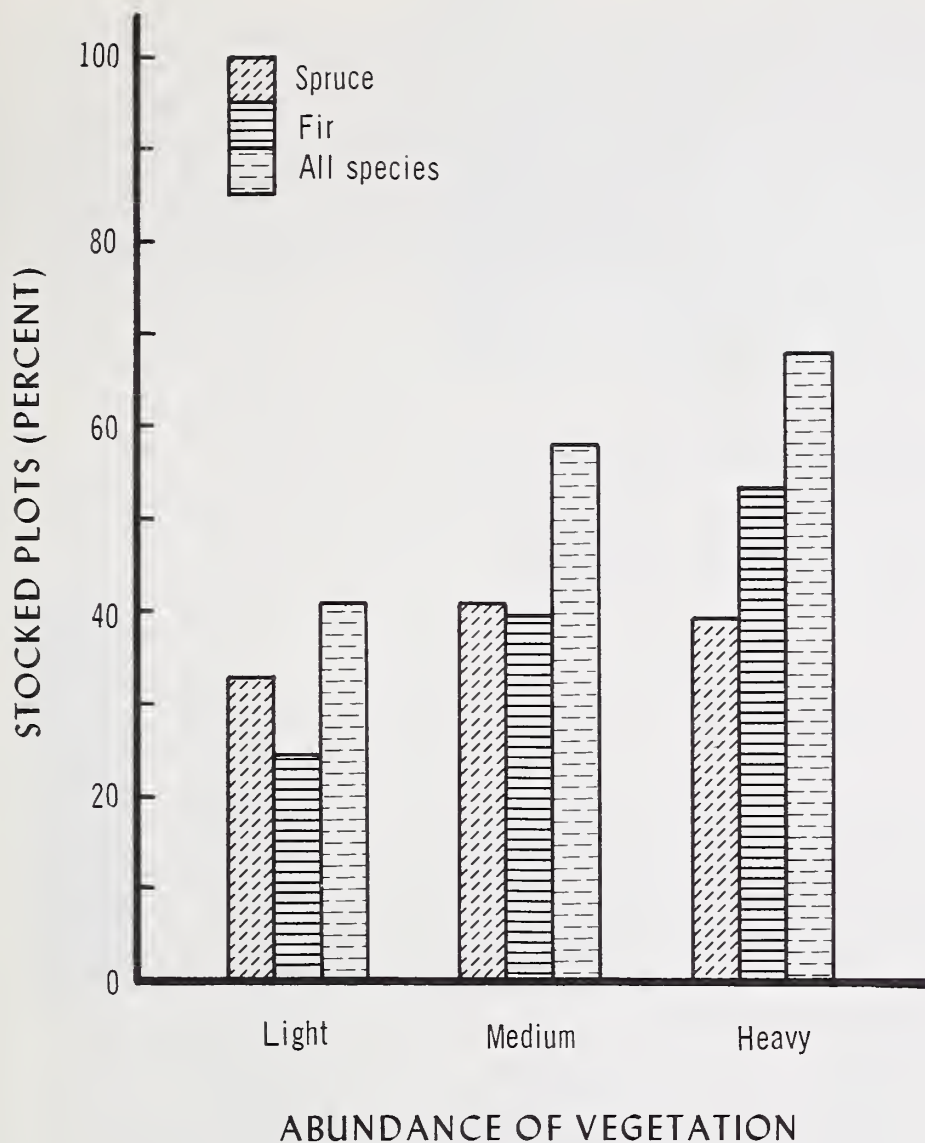


Figure 6.--Average stocking to subsequent reproduction, by abundance of vegetation.

Table 1. --Relation of average stocking to subsequent spruce and fir by soil type and length of time since timber harvest

Characteristics of area	Percent of total sample	Percent of species stocked		
		Spruce	Fir	All
Parent soil material and texture:				
Sandstone (Light)	41	47	51	69
Granitic (Light)	38	34	27	46
Other (Medium)	21	27	30	42
All	100	38	38	54
Length of time since timber harvest:				
3 years	20	17	7	19
4 years	38	34	46	60
6 years	18	43	46	62
7 years	24	56	42	69
All	100	38	38	54

Average stocking to subsequent reproduction was nearly as good as stocking to advanced reproduction. Furthermore, subsequent spruce was stocked on as many sample plots as subsequent fir, and stocking to spruce has continued to improve with time.

Composition and stocking of subsequent reproduction was related to the several environmental factors and cutting-unit characteristics observed. Conditions where stocking to subsequent spruce and fir was above and below average are shown in table 2. Stocking to spruce and fir each averaged 38 percent.

Table 2. --Stocking of subsequent reproduction and its relation to environmental factors and cutting-unit characteristics

Characteristics of area	Engelmann spruce		Subalpine fir	
	Average or above	Below average	Average or above	Below average
Seedbed	Disturbed and skidroad	Undisturbed	Undisturbed and disturbed	Skidroad
Ground covered with slash	Less than 40 percent	40 percent or more	Less than 40 percent	40 percent or more
Aspect	N, NE, E, W, NW	SE, S, SW	N, NE, E, W, NW	SE, S, SW
Average density of ground vegetation	Medium to heavy	Light	Medium to heavy	Light
Slope	Above 25 percent	25 percent or less	Above 25 percent	25 percent or less
Length of time since areas cut	6-7 years	3-4 years	4-7 years	3 years
Relation of cutting unit to contour	At right angles	Parallel	Parallel	At right angles
Width of cutting unit	200 feet	400 feet	400 feet	200 feet
Soil texture and derivation	Light textured, derived from sandstone	Light textured, derived from granitic rock; and medium textured, derived from various parent materials	Light textured, derived from sandstone	Light textured, derived from granitic rock; and medium textured, derived from various parent materials